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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Marine Reciprocating Steam Engines and Auxiliaries

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
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Lubrication of Marine Reciprocating Steam Engines and Auxiliaries

IN THE field of marine engineering the lubrication of reciprocating steam engines, engine room and deck auxiliaries is one of the most important features of modern ship operation. The reciprocating steam engine as a means of ship propulsion is still a decided factor notwithstanding the growing popularity of the steam turbine and the Diesel engine. These latter have been discussed in detail in previous issues of LUBRICATION*. Therefore it is essentially with the reciprocating steam engine and the various engine room auxiliaries used on shipboard that this article has to deal.

The Main Engine

Marine reciprocating steam engines are classified today according to the general arrangement of their working parts, i.e., whether they are (1) horizontal, (2) vertical or (3) inclined; whether they are (1) condensing or (2) non-condensing; the number of expansions such as (1) simple, (2) compound, (3) triple, and (4) quadruple; and according to the type of propulsion. In regard to this latter it may be said that the screw propeller has practically superseded all other means of drive, such as the side and stern paddle wheel, except in craft for service in very shallow waters.

In the earliest types, marine steam engines were built horizontally. With such equipment the paddle wheel was the usual means of propulsion. Steam boiler development, however, with consequent increase in steam pressures later led to curious and intricate variations in engine construction, including such arrangements as the oscillating engine, beam engines, side lever construction, inclined engines, and the trunk engine. These early types of engines developed relatively slow speeds, so when the screw propeller was introduced, gearing was adopted to speed up the shaft to gain the required propeller efficiency. From this stage the transition to the basic modern vertical multiple expansion, condensing engine was rapid. Though the latter passed through many stages of mechanical development, in reality the increase in power that was possible, due to increased steam pressures, was the essential governing factor. To obtain the full benefit of such high pressures, multiple expansion engines were designed, equipped with two or more cylinders of increasing size in order to reduce the effects of cylinder condensation by the reduction of the temperature range each was subjected to.

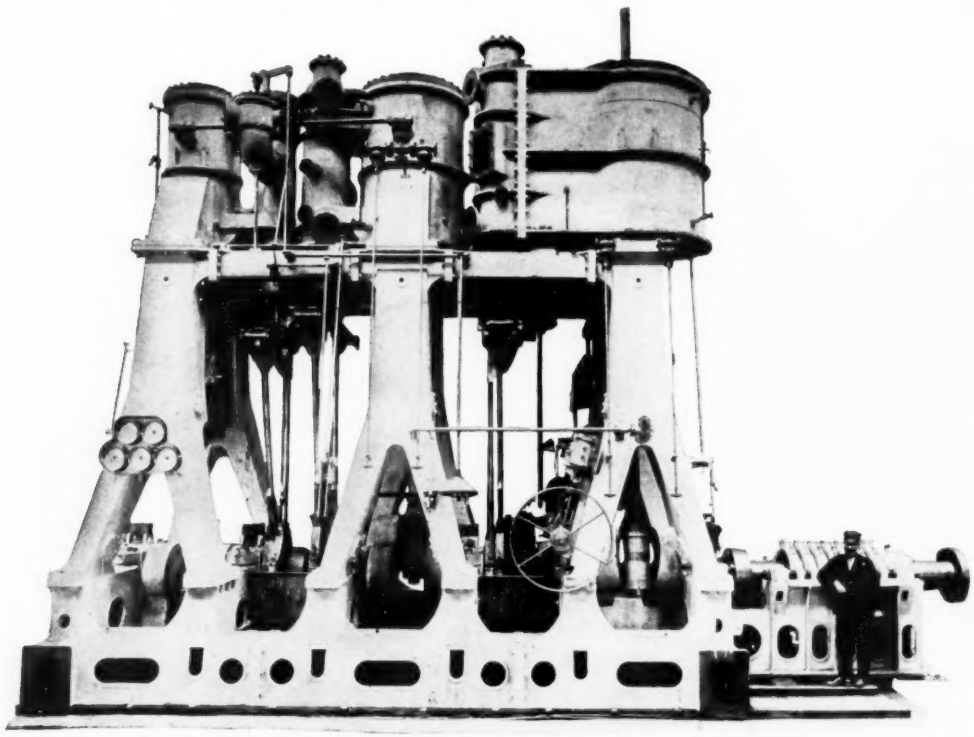
Today the cylinders of a multiple expansion engine may be arranged in a number of ways in regard to their location, crank angles and the sequence in which cranks operate. In a compound engine there may be two or three cylinders and one or two cranks. Certain earlier designs located the high pressure cylinder above the low pressure or in a vertical com-

*Lubrication, Feb., Apr., Sept., Oct., 1921 and March, 1922.

pound or steeple arrangement. This idea was also sometimes applied to triple and quadruple expansion engines, which were built respectively with three or more, or four or more cylinders. In modern practice the vertical tandem or steeple idea is practically obsolete and cylinders are located fore and aft on the same level.

Lubrication

The essential parts of the modern steam engine which require lubrication of some form or other, are the steam cylinders, pistons, valves, valve chests, valve stems and piston rods, crosshead, guides, crank pins, main bearings and the various moving parts of the valve gear. Lubrication of such an engine can be broadly treated as internal and external. In turn, external lubrication may be carried out by hand, oil cups, wick feeds, gravity or forced feed. Internal lubrication applies solely to the cylinders, piston and valve wearing surfaces. In the vertical steam engine it is evident that there will be equal pressure exerted on all parts of the cylinder surface by the piston and rings, and on the valve seat by the valve itself. In other words, the condition of part of the cylinder carrying the weight of the piston, and the valve seat carrying the weight of the valve, as is usual in a horizontal engine, is absent. Hence there is not the need of as perfect a film of cylinder lubricant as in the horizontal engine. In fact, in the average case where saturated steam is used water is allowed to act as the lubricant, the steam having sufficient moisture content to serve this purpose. Ultimately, a cylinder so lubricated will acquire what is known as a "water polish" or a protecting film of low c efficient of friction.



Courtesy of New York Shipbuilding Corp.

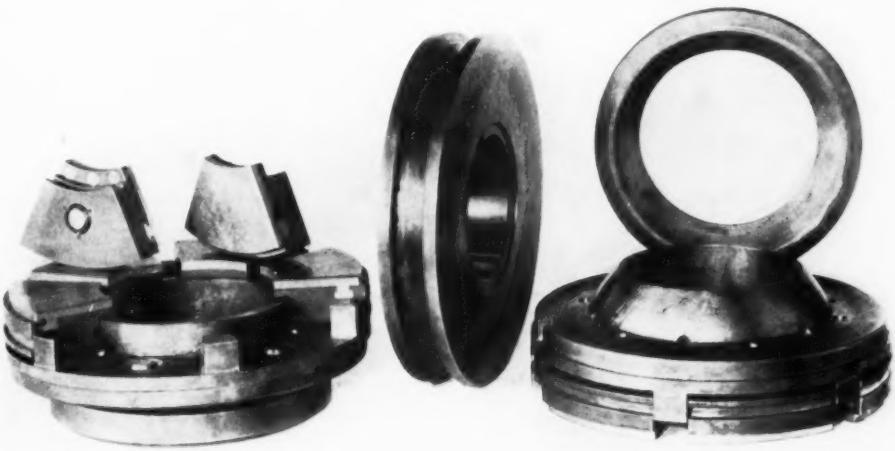
Fig. 1.—Side elevation of a modern triple expansion reciprocating marine engine, size: 25" x 42½" x 72" / 48"

Note the gear wheel of the jacking engine between intermediate and low pressure sections; and horse-shoe type of Thrust Bearing to the ri

In event of using highly superheated stea it has been found best practice to use a slight compounded cylinder lubricant wherever po sible. The base should be a pure petroleu product having a viscosity of about 160" Sa bolt at 210° F. However, a marine steam cy inder lubricant should never contain any fix oil or animal compound, unless an oil separat or grease extractor is installed in the feed lin to take care of any fixed oils that are likely

find their way to the boiler, or unless the engine is non-condensing. If there is no condensation there is normally no necessity for emulsion or lathering when using mineral cylinder oils; were fixed oils compounded with them there would be the probability of their being carried over to the hot well in the condensate, to subsequently enter the boilers in the feed water where they might cause damage through blisters, or collection on certain of the heating surfaces. Certain cases may arise, however, in engines of several expansions and low conditions of superheat where the exhaust from the intermediate pressure cylinders will be relatively wet steam. Provided that a suitable oil separator is installed reservoir. In addition the amount of oil fed into the lubricating line will be independent of the load and the speed of the engine. There is also possibility of a hydrostatic lubricator being overlooked, especially when the engine is shut down, with the result that excessive oil will accumulate at the throttle, to be shot into the high pressure cylinder in bulk when the engine is again put into operation.

In the lubrication of the external moving parts as listed above, due to the prevalence of water either from leaks, condensed steam or the water cooling system when wick feed or hand oiling is used, it is necessary that the lubricant include a certain amount of fixed oil compound



Courtesy of Kingsbury Machine Works and Kerr Turbine Co.

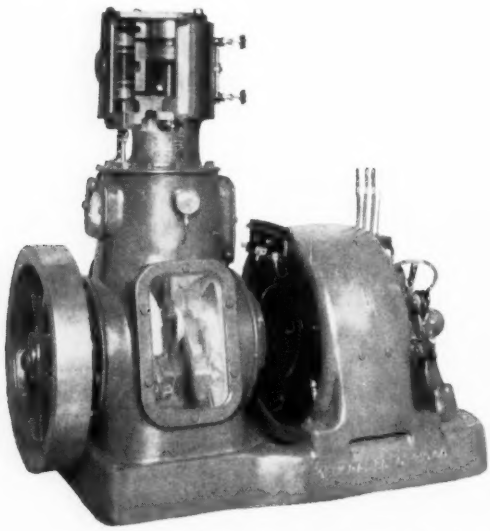
Fig. 2. The essential working parts of the Kingsbury type of thrust bearing. This bearing will take thrust in either direction, the shaft being attached to the central bearing ring. Notice bearing shoes and pins upon which they rest.

(as already mentioned) a cylinder lubricant with a low percentage of animal (fixed oil) compound may be advisable to insure that the low pressure cylinder will receive proper lubrication. This matter of Steam Cylinder Lubrication was discussed in detail in LUBRICATION for June, 1921.

In the application of such lubricants a mechanical lubricator will be generally most economical and dependable. The hydrostatic type of lubricator which works on the principle of forcing the oil into the lubricating line by means of a head of water produced by condensed steam, is somewhat erratic, and a condition may occur to interfere with constant and regular flow of the oil as in filling the oil in order that it will form a heavy, adhering lather when in contact with water. Wick feed systems are the most commonly found on merchant ships. Essentially this is mechanical lubrication though it requires strict and careful attention. Generally it consists of a manifold connected by brass pipes to the various parts to be lubricated. The ends of these pipes should extend above the normal oil level in the manifold, to within about two inches of the top. The feed is regulated by worsted yarn wicks, fitted with a lead sinker on one end and a twisted wire on the other. The sinker ends are submerged in the oil contents of the manifold, the wired ends being inserted in the feed pipes. Oil travels up the wicks by capillary action and

siphons over, to subsequently drip into the pipes and be led to the various parts requiring lubrication.

Wicks should be stripped once every watch to prevent gumming of the oil and cessation of lubrication. The entire wick should never be too heavy, and judgment must be used in deciding on the number of strands suitable. Were too many strands used, capillary action would be retarded and if the wick were



Courtesy of General Electric Co.

Fig. 3.—Steam engine driven generating set, designed for forced lubrication. Section of cylinder and doors are removed to show valve, piston, crankcase and lubricating system.

not regularly stripped, lubrication might even be discontinued. As a safeguard in wick feed lubrication hand oiling is generally resorted to whenever the oiler makes his rounds. It must be borne in mind that overheating of marine engine bearings is a far more serious matter than it would be in stationary practice. For wick and hand feed lubrication, marine engine oil should have a viscosity of about 650″ Saybolt at 100° F.; it is generally compounded with blown rapeseed oil in varying percentages up to 20% which is generally considered best practice.

Forced feed lubrication is customary in naval practice. Since the possibility of contamination with water is reduced, it is customary to use a straight mineral oil of from 300 to 500″ Saybolt viscosity at 100° F. All working parts of the main engine except the valve gear but including the thrust bearings, are served in this manner. Each engine is usually fitted with its own individual pumping system. The entire engine is enclosed in a sheet steel casing to prevent splashing and waste of oil and enable the return of used lubricant to the filter and service tank.

On the reversing mechanism, which is usually of the Stephenson link type, it is important to watch the link block carefully and lubricate it regularly when in use. There is so little motion here that the tendency of the oiler will be to overlook it, with the result that it will quickly run dry due to the heat received from the valve chest, and excessive wear will occur on the brass shoes between which the link moves.

Jacking Engine

In order to turn the engine any part of a revolution or if desired, several revolutions, when making repairs, setting valves or to conform to port or naval requirements when the ship is in port, a jacking or turning engine is always installed as part of the main engine equipment. On smaller ships a more or less simple hand jacking arrangement will suffice, but on larger engines a steam driven worm and wheel device is usual. It is built capable of being disengaged and locked out of gear when the ship is under way, and is generally operated by a small single or compound steam engine capable of turning the main engine at relatively low speed with a steam pressure of 80 lbs. or less. The jacking engine should always be so equipped that it will turn in either direction as desired. Usually a differential valve is installed for this purpose. The gear or pinch wheel is generally keyed on the crank shaft. It is built of cast iron. The worm is commonly of brass and may be designed for either horizontal or vertical operation.

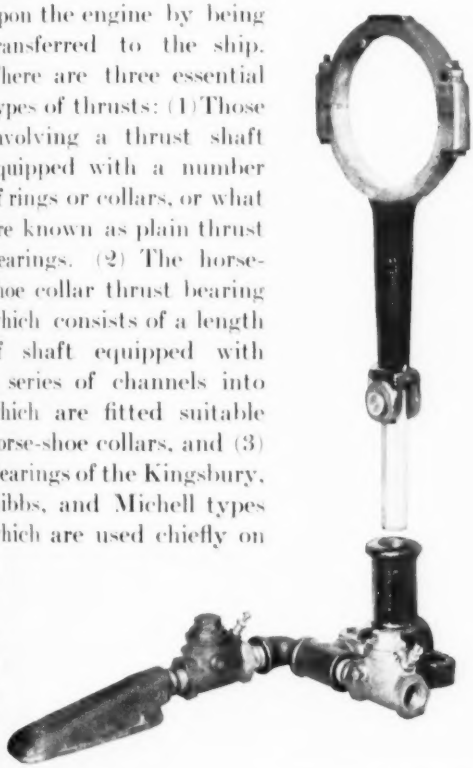
Lubrication

In general the lubrication of a jacking engine is simply a matter of hand oiling whenever it is in operation, using marine engine and cylinder oils, and a good pure mineral gear compound of about 1000″ Saybolt viscosity at 210° F. on the worm and gear. Wherever the throttle valve is not tight a certain amount of steam leakage will occur when the gear is idle. The condensate from this will tend to drip into the steam end and cause rusting of the cylinder

walls and valve seat. Therefore it is advisable in such a case to give the steam unit a shot of oil at frequent intervals.

Thrust Bearings

Although not essentially a part of the main engine, nor yet an auxiliary, the thrust bearing is a distinct piece of equipment and its lubrication is very important. The thrust bearing is the connecting link between the propeller shaft and the main engine shaft. Here the thrust exerted by the propeller is taken off the crank shaft and kept from acting upon the engine by being transferred to the ship. There are three essential types of thrusts: (1) Those involving a thrust shaft equipped with a number of rings or collars, or what are known as plain thrust bearings. (2) The horse-shoe collar thrust bearing which consists of a length of shaft equipped with a series of channels into which are fitted suitable horse-shoe collars, and (3) Bearings of the Kingsbury, Gibbs, and Michell types which are used chiefly on turbine installations, that consist essentially of a body containing rings or a number of slippers mounted on spherical seats. The slippers and rings are designed to bear on opposite sides of a single thrust collar on the shaft. The load on such bearings is uniformly distributed. Contact between the sliding elements and the thrust collar is prevented by a film of oil which adheres to and rotates with the moving parts.



Courtesy of General Electric Co.

Fig. 4. Strainer, valves, oil pump and eccentric strap, as installed in the generator set shown in Fig. 3. The pump is of the single acting plunger type driven by an eccentric bolted to the crankshaft. Thus oil is forced from an oil sump in the base under pressure to the various bearings of the engine, and lubrication is positive at all times.

Lubrication

Thrust bearing lubrication is important inasmuch as overheating of the rings, collars or slippers due to lack of oil will rapidly cause scoring of the bearing metal, with the necessity of serious cessation of entire ship operation for repairs. Wick feed, force feed or bath lubrication is generally employed. Of these, force feed is usually preferable on the patent slipper type of bearings as mentioned above, in order to insure a uniform film of lubricant at all times. In such a system a pure mineral oil should always be used, inasmuch as a compounded oil will have a tendency to emulsify in contact with water, with the detrimental results as discussed hereafter. The thrust bearing housing should be kept filled with clean oil to a level recommended by the builder. Leaks should be guarded against inasmuch as lowering of the oil level unobserved would result in probable overheating. Dirt, grit and other foreign matter are serious factors in the lubricating system of a thrust bearing, and may involve scouring and wearing down of the bearing faces, and overheating. As a general rule an oil for such service should be a straight mineral product having a viscosity of about 300″ to 500″ Saybolt at 100° F. Thrust oil properly chosen and applied will last for a considerable period if no objectionable features are allowed to interfere with the lubricating system.

Wick feed supplemented by bath lubrication is generally found on horseshoe and plain thrust bearings. The same oil as used on the main engine is suitable for this service. Considerable care must be exercised constantly in lubricating thrust bearings of these latter types due to the usual practice of running with an emulsion of water and oil. During continued operation this emulsion will tend to become heavier and heavier until the oil ways will ultimately be so clogged that relatively the only lubrication possible will be furnished by the wick feeds. Thus overheating will be probable. Therefore the engineer should watch the nature of this emulsion carefully, and as soon as it shows a tendency to thicken abnormally, the bearing should be thoroughly cleaned out and the oil renewed.

Tunnel Bearings

Tunnel bearings as usually installed in connection with the average reciprocating steam engine, are of the plain spring type. Their purpose is to carry the main shaft between the thrust and the stern bearing, and the number installed will depend, of course, upon the length of the shaft. Tunnel bearings are usually lubricated either with marine engine oil or a tunnel bearing grease. When oil is used it is generally applied by means of wick feed, the top half of the bearing cap being built with an oil box cast on the top side. This oil is generally reclaimed and used over and over again. Where tunnel bearing grease is used it is comparatively hard and has a melting point of approximately 200-210° F.

Construction of the bearing cap differs somewhat when grease is to be the lubricant, i.e., instead of an oil box on top of the cap there is an opening wherein the grease is placed and allowed to rest on the shaft.

Generator Sets and Motors

Electric generator sets are essential equipment on the modern steamship, whatever its type or service. The numerous uses to which electric motors may be put, such as in the machine shop, driving deck machinery and centrifugal pumps, and also the necessity for lighting the ship by electricity, the operation of searchlights and frequently the use of electric current for heating and cooking, have caused the electric generator to become probably the most important auxiliary in the engine room. Such equipment is generally steam driven, by direct connected reciprocating simple vertical engines of the short-stroke high speed type, built for gravity or forced feed lubrication. Turbo-generator sets are also sometimes used.

Direct current generators are most commonly used in marine service, due to their simplicity and also to the fact that they do not require separate field excitation. The marine generator is generally built compound wound with four or six poles. Storage batteries are a required installation on all sea-going ships equipped with wireless. These serve as an emergency source of power for the radio in event of the main electric plant being out of commission, and should have a capacity for several hours of operation.

Lubrication

While the modern marine generator set will be usually equipped for forced or gravity lubrication of the steam unit, wick feeds or even hand oiling may be found in certain engines. On enclosed crankcase machines a straight mineral oil of about 180″ viscosity Saybolt at 100° F. that will not emulsify under ordinary conditions should be used. Where sight feed lubrication is called for as on many older type engines, any grade of marine engine oil will be suitable. Generator bearings are generally of the ring or chain oiled type and lubrication is relatively automatic; a straight mineral oil of about 180″ viscosity Saybolt at 100° F. is best. It will be advisable to swab piston and valve rods of the engine at each oiling inspection

Courtesy of Worthington Pump & Machinery Corp.

Fig. 5.—Box chest type of vertical Duplex Piston Ballast Pump. This pump is built for lifting large quantities of water or other liquids.

the machine, using the same cylinder oil as on the main engine. No internal steam cylinder lubrication is advisable for the same reasons as mentioned heretofore under "Main Engines".

Motor lubrication is essentially simple and usually automatic. Bearings are fitted with ring or chain oilers, and it is only necessary to keep the oil reservoirs properly filled with the same grade of oil as above.

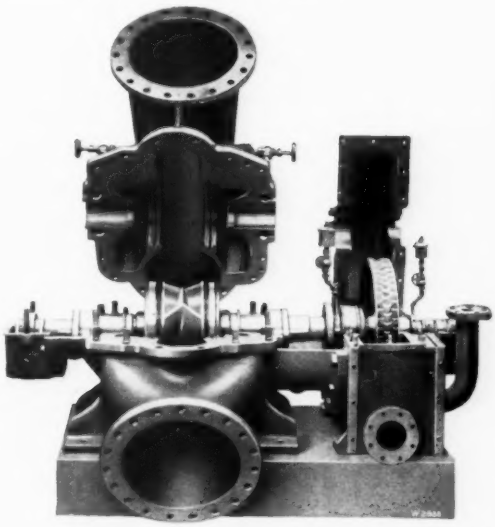
Pumps

Pumps occupy a most important place in marine practice, and upon their serviceability largely depends the efficiency and safety of the ship at sea. They are installed to perform numerous duties, such as

(a) To furnish feed water to the boilers.
(b) For fire protection purposes.
(c) To free the bilges of any excessive water.
(d) To maintain a suitable vacuum in the main and auxiliary condensers.
(e) To circulate cooling sea water through the condensers and return it overboard.
(f) For sanitary purposes, in flushing toilets, and bath uses.
(g) To feed the evaporator if one is installed.
(h) To pump fresh water to such parts of the ship as desired.
(i) To pump the condensate from the condensers to the hot-well or feed tank when these auxiliaries are not direct connected for passage of the water by gravity.
(j) For furnishing forced feed lubrication.
(k) For pumping fuel oil to the burners when the boilers are equipped for oil burning.
(l) For furnishing circulating water to the ice machine.

In the above service the horizontal or vertical reciprocating pump predominates. For feed water purposes vertical installations are customary, the pumps being designed for relatively long stroke and slow service. An auxiliary feed pump is also frequently installed, similar to the main feed pumps, though often smaller. The fire pumps are generally combined in a duplicate set of high pressure duplex, horizontal pumps. They are usually the largest pumps in the ship inasmuch as when required in an emergency their discharge must be great. They are piped and manifolded so as to take suction either directly from the sea (in case of fire) or from the bilges in event of leaks. It is also advisable to have their discharge and suction so manifolded that they can be used to feed sea water to the boilers in event of breakdown of all the boiler feed pumps at the same time. Other reciprocating pumps such as the fresh water, bilge, hot-well, sanitary, fuel oil, and evaporator pumps are usually of horizontal, simplex, low-pressure type, installed in duplicate.

The circulating pump which furnishes the sea water for cooling the condenser is generally of the centrifugal type operated by a turbine or twin-cylinder compound, vertical reciprocating steam engines installed in duplicate, one connected to each end of the impeller shaft. Oftentimes in Naval service the sanitary pump will be a steam or motor driven centrifugal pump instead of a reciprocating type.



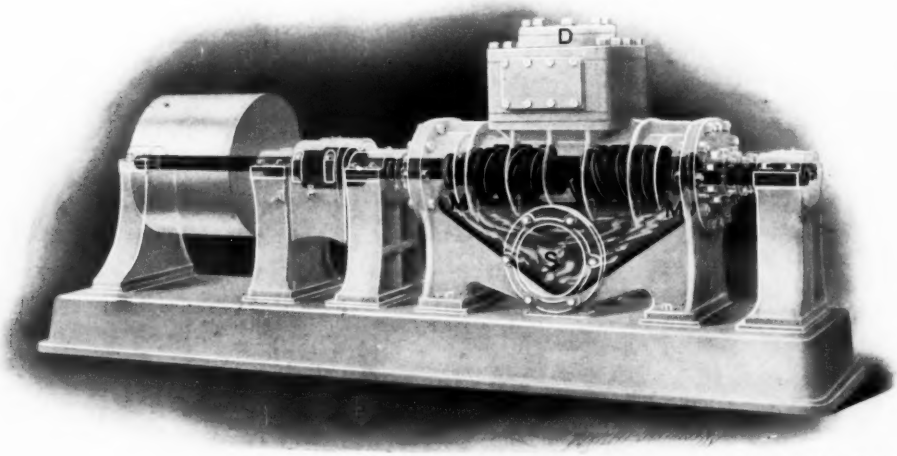
Courtesy of Worthington Pump & Machinery Corp.

Fig. 6.—Sectional view of a typical circulating volute pump direct connected to a steam turbine. This type of pump is popular for the circulation of cooling water to the main condenser. Lubrication is confined essentially to the bearings as shown.

The air pump attached to the main condenser for removing air and condensed water is usually of the vertical type fitted with three sets of lift valves, i.e., one set in the head, one set in the foot, and one set of bucket valves in the piston itself. It is customary to drive such a pump by a vertical, single-acting walking-beam mechanism directly connected to the low pressure crosshead of the main engine. On the other hand, sometimes the air pump is driven by an independent engine of its own, of the

twin-cylinder, vertical, single-acting beam type; or an air ejector and condensate pump may be used. The auxiliary condenser pump is usually of the ordinary piston type, the steam driving mechanism being installed in the center, with one end of the piston rod connected to the piston in the air cylinder, and the other end operating the water cylinder piston.

Pumps for furnishing forced feed lubrication are of the simplex low pressure type and are generally installed in duplicate at the lowest point possible. The method of installation of the only requisite is that the moving parts shall be periodically oiled when under operation. Disregard of this, however, would normally not result in serious shutdowns as in the case of certain other auxiliaries. Reciprocating pumps require lubrication only on their rocker arm pins, valve connecting mechanism and steam piston and valve rods. The water or oil sides do not require lubrication. Hand oiling and swabbing of the rods with engine and cylinder oils of the same grades as used on the main engine is customary.



Courtesy of Quinby Pump Compa

Fig. 7.—Phantom view of a screw type pump frequently used for fuel oil service. In this pump the screws act as pistons in propelling the liquid through the pump chamber. The essential features are lack of pulsation, simplicity, and fewness of bearings requiring lubrication.

such pumps varies, although they should always be designed so that they are interchangeable, any one being capable of performing the duties of the others. Usually a service pump is installed, taking suction from the supply tank, for serving the main engine, shaft and thrust bearings, circulating pump,—a return pump being furnished for transference of the oil from the oil well and storage tanks to the settling supply and storage tanks.

Many of the above are being replaced by turbine driven machines. These are lubricated usually by force feed with a pure mineral oil of about 300″ to 500″ Saybolt viscosity at 100° F. Oil reservoirs hold from 5 to 10 gallons of oil and bearing lubrication alone is necessary. Thus the oiling problem is materially simplified.

Lubrication

Pump lubrication is essentially simple and

In the case of centrifugal pumps, hand wick feed oiling is customary on the driving unit using the same oil as on the main engine. Forced feed lubrication is used, however, when such a system serves the main engine. Wick feed is more positive than hand oiling and is to be preferred inasmuch as the high speed of a centrifugal pump and its driving engine requires constant and uniform service. In this case the only care is to periodically inspect the wicks as to their action and to keep the manifold box properly filled with oil. Water lubrication is generally used on the bearings of pumps employed for water service

Ice Machines

Although the ice machine is the only part of the refrigerating plant that requires lubrication a word as to the plant itself is of interest. Normally the marine refrigerating plant will

sist of the ice machine and its accompanying refrigerating chambers. The usual size of the plant will vary from ½ ton to perhaps 20 tons according to the type of ship. On cargo ships a tonnage of from ½ to 3 is usual, but on large passenger liners and refrigerating ships machines of as high as 10 to 20 tons are found. The tonnage is based on the cooling effect of the system in tons of ice per day. From an actual ice-producing viewpoint this means that the tons of ice will be about one-half the rating of the machine, i.e., a 1-ton machine will have the cooling effect of one ton of ice but will actually make about one-half a ton per day.

There are a number of types of ice machines in use today, involving cooling by (1) The expansion of air which has previously been compressed and cooled, the apparatus being known as the dense air machine. (2) By the use of carbon dioxide, CO_2. (3) Sulphur dioxide, SO_2, (4) Ethyl chloride, and (5) Ammonia. The latter is most commonly found in the merchant marine, the other four types being more particularly designed for Naval service.

Lubrication

Owing to the relatively low temperatures encountered in certain of the working parts of an ice machine the essential characteristic of the lubricant is that it shall have as low a pour test as possible. In the dense air machine the oil used in the expander valve chest and cylinder should be light in order that the viscosity shall not be too great at the low temperature under which it must work. A trap is generally installed to retain such of this oil as may have become entrained with the expanded refrigerated air before the latter is passed to the distributing system. For this service a pure filtered mineral oil of about 100″ Saybolt viscosity at 100° F. is best suited. On the other hand in the compressor cylinder and valve chest of such a machine the temperature will be so much higher that an ice machine lubricant of the above grade will be usually too low in viscosity for effective service. However, the regular ice machine oil should be used wherever possible inasmuch as leakage, or a certain amount of the heavier oil carried over by the air from the compressor to the expander will frequently result in gumming. Where necessary to use a heavier oil, a straight filtered mineral product of 200″ Saybolt viscosity at 100° F. will be suitable. Sight feed lubrication is the usual practice on such machines. Steam cylinder lubrication is generally not attempted if the exhaust from the steam unit is to be re-used as boiler feed water. What little external lubrication of

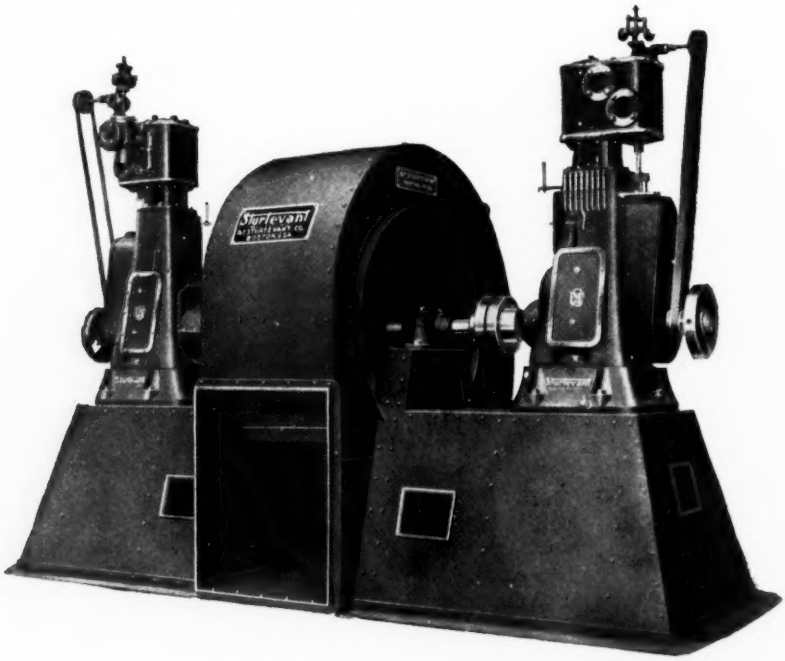
Courtesy of Brunswick-Kroeschell Co.

Fig. 8.—Phantom view of a vertical 1-ton Ammonia Compressor, showing interior construction. This machine is designed for splash lubrication of the working parts.

piston and valve rods and other wearing parts as is deemed necessary, is carried out by hand oiling when the oiler in charge of the ice machine makes his regular inspection. The greatest of care must be observed in keeping compressors and expanders properly lubricated inasmuch as should they run dry the valve seats will become quickly scored and cut.

In the ammonia refrigerating apparatus it is

most important that the compressed gas be discharged as completely as possible from the compressor at the end of each stroke to prevent re-expansion on the return stroke, and the lowering of the capacity of the machine. This is overcome by means of injecting lubricating oil into the compressor at each stroke after compression of the gas has begun. The oil fills all crevices and clearance spaces and prevents the retention of any of the gas therein. Of course, it also serves as the lubricant for the moving parts, piston and valve rods, as a stuffing box seal, and to partly absorb the heat of compression. Any excess oil that is retained in the gas is usually collected by an oil cooler or separator, from whence it is returned to the oiling system. For this purpose on vertical machines a pure mineral oil of approximately 100″ Saybolt viscosity at 100° F. is best suited. Where leakage is apt to occur or, if the machine is of the horizontal type, it may be advisable to substitute a somewhat heavier oil for the above, in this case using an oil of approximately 200″ viscosity Saybolt at 100° F. This will give a more dependable seal. In addition, in a horizontal machine the lower part of the cylinder walls carries the weight of the piston, thus requiring a heavier oil to furnish a suitable supporting film. Where the compressor is so built that relatively metal to metal contact occurs between the piston and head of the compressor there is practically no clearance space. Thus there will be little or no need for the use of oil as explained above. Lubrication in this event is all external and can be carried out at the regular inspection period, using ordinary engine oil. Lubrication of the attached steam engine is similar to that of the engine equipment used in the generator set.



Courtesy of B. F. Sturtevant Co.

Fig. 9.—An engine-driven forced draft fan. Duplicate vertical reciprocating engines are usually installed with such a fan, though motor drive is not infrequent. The essential advantage of the former is that comparatively low speeds can be easily maintained with uniformity.

Blowers and Fans

When forced draft is necessary in firero operation, or whenever mechanical ventilati is desired, it will be necessary to install blow or centrifugal fan equipment to furnish t proper amount of air under light pressure. E sentially a blower consists of a set of steel va either flat or slightly curved, mounted radia on a shaft and enclosed in a suitable cas While the blower is still much in use, centrifu fans are becoming very popular today in m ern practice due to their compact construct Whatever the design, the main shaft is dri

either by direct connected electric motor, steam turbine, or a vertical reciprocating engine such as is used for driving the generator set. The latter method is the most common in merchant marine practice. When rotated the fan or blower vanes generate a circular motion or current to the air drawn in and by virtue of centrifugal force this air is forced to the tips of the blades. By this action a certain amount of pressure is developed and thus the air contained will be passed out into the space to be ventilated or through the outlet in the casing, as construction may allow for. As long as the machine rotates, this pressure will be maintained and a uniform current of air delivered, its place being constantly taken by fresh air through the hub inlet in the casing.

Lubrication

Blower and fan lubrication is relatively simple. The shaft bearings are generally ring or chain oiled and only require periodic filling with a straight mineral oil of about 180″ Saybolt viscosity at 100° F. The driving unit is lubricated according to its type as has been elsewhere explained.

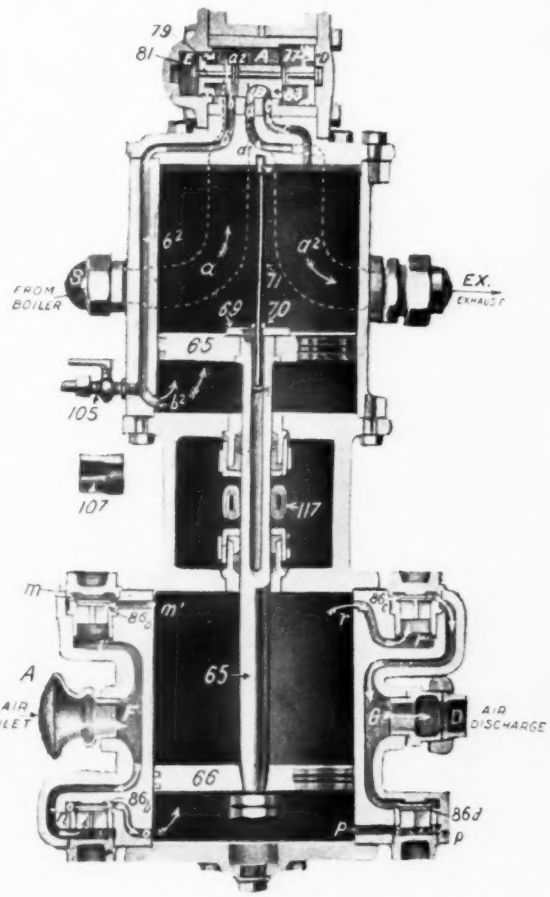
Air Compressors

While the use of compressed air is not a general feature in the merchant marine, it is usually prevalent on naval vessels. The general purpose of compressed air on shipboard is for operating pneumatic tools, cleaning fuel oil burners and tips, as an atomizing agent in certain types of fuel oil burners, for pneumatic hoisting devices, to furnish a means of blowing soot from boiler tubes, and for certain ordnance operations in battleships such as cleaning guns of waste gases after firing. Usually the marine type of air compressor is simple or single stage, much similar to the locomotive compressor, though two-stage machines are sometimes used in the Navy. Such machines are usually built vertical, being double acting, and the steam and air pistons are mounted on the same piston rod.

Lubrication

Air compressor lubrication is important inasmuch as failure in the lubricating system even for short periods of time may prove disastrous to the equipment. To gain proper results such lubrication must be maintained at a certain very definite rate, and at no time to an excessive extent. Too much oil will mean an accumulation of carbon which will result in improper valve action, clogging of pipes and other oil ducts, with a consequent rise in the compressor temperature. Kerosene should never be used to clean valves and other parts of the machine. For this purpose hot lye water is the best cleansing agent.

For compressor service a low viscosity oil has been developed as productive of the least amount of carbon. It should not be so light, however, as to give rise to an imperfect lubricating film. For this service a pure filtered mineral oil of from 200″ to 300″ Saybolt viscosity at 100° F. is considered best.



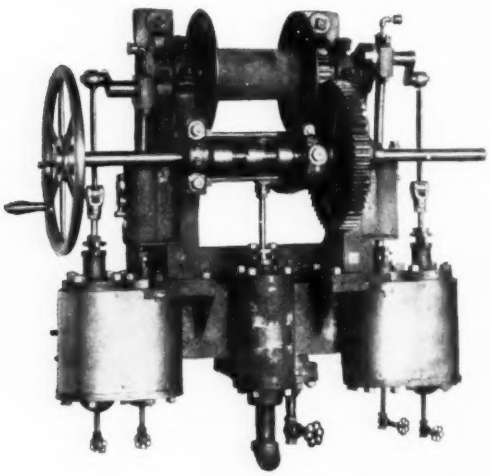
Courtesy of Westinghouse Air Brake Co.

Fig. 10.—Sectional view of a steam driven single-stage air compressor. In this machine the movement of steam piston 65 is imparted to the air piston 66 by means of the common piston rod. Lubrication of the air cylinder is effected by periodically opening an oil cock, when the piston begins its down stroke, and closing it before the beginning of the up stroke.

The steam cylinder is rarely lubricated internally, for the same reasons as given heretofore. Such external lubrication as is necessary is carried out by hand, using the regular grade of marine engine and cylinder oil as is furnished for the main engine.

Ash Hoists

While any of the usual types of winches may very frequently be used for the hoisting of ashes, usually a special design of ash hoisting engine is preferable. Thereby the machine can



Courtesy American Engineering Co.

Fig. 11.—Type of steam driven ash hoist engine commonly used in marine practice. Operation is governed by the hand wheel which causes a spur gear to rotate, thus operating the differential valve which admits steam to the engine to turn the drum shaft. If the hand wheel is turned in the opposite direction a reverse movement is obtained.

be stopped automatically at any desired stage of the lift, and this height can be varied without special adjustment. The principle of operation of such a machine is very similar to that of the indirect connected steam steering gear explained in a later article. The steam power mechanism in this hoist is generally a twin cylinder piston valve engine designed for either direct or indirect drive of the drum shaft, this latter being connected by spur reduction gearing to the automatic operating mechanism. General operation embodies the principle of follow-up motion, wherein turning of the hand-wheel automatically opens the steam control valve to cause the engine to start. This operation continues only as long as the hand wheel is being turned. Adjustable stops are attached which control the running of the hoist to definite limits of travel between the fireroom floor and the point of discharge.

Electric motor drive is also found in ash hoist construction. In such a device the speed of the motor is reduced by suitable reduction gearing to the desired drum speed. Motor control is automatic as in the steam driven hoist. Electric hoists are not generally found in steamship operation unless unusual conditions warrant their installation.

Lubrication

Steam driven ash hoist lubrication is much similar to the lubrication of other geared auxiliaries. Gears and bearings are the usual points requiring attention. Pinions, spurs and main gears as well as the threaded handwheel shaft will require a gear lubricant similar to that used on the anchor engine. It must be capable of adhering tenaciously to the teeth and must not drip or be thrown off by centrifugal force. Oftentimes the ash hoist will be exposed to the heat of the fireroom and in this event the viscosity of the gear lubricant should be increased. For this service a straight mineral lubricant of from 1000″ to 2000″ Saybolt viscosity at 210° F. will be suitable.

For general lubrication of bearings and wearing parts of ash hoist control mechanism the same grade of engine oil as is used on the main engine will be suitable. Waste pad lubrication or simply oiling by hand is the most prevalent practice. For lubrication of motor driven hoists use the same oil as on the generator set.

Note:—The subject of Deck Machine Lubrication will be discussed in a later issue of LUBRICATION.

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